NON-PUBLIC?: N
ACCESSION #: 9207060235
LICENSEE EVENT REPORT (LER)

FACILITY NAME: St. Lucie Unit 2 PAGE: 1 OF 04

DOCKET NUMBER: 05000389

TITLE: Manual Reactor Trip due to Local Power Density Control Problem Caused by Axial Shape Index Guideline Deficiencies
EVENT DATE: 04/21/92 LER #: 92-001-01 REPORT DATE: 06/29/92

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: POWER LEVEL: 015

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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Technical Advisor

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: JJ COMPONENT: 62 MANUFACTURER: A348
X JJ PSV P070
REPORTABLE NPRDS: Y
Y

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

On 21 April 1992, with Unit 2 in Mode 1, a plant shutdown was in progress for a scheduled refueling outage. Difficulty in maintaining Axial Shape index within limits was expected during the downpower. When reactor power reached approximately 15% three of four local power density pre-trips in the reactor protection system alarmed. The nuclear plant supervisor directed a manual reactor trip at 0238. On the manual reactor trip the turbine did not trip automatically, but remained tied to the system grid carrying approximately 90 megawatts. Several additional attempts were made to trip the turbine from the manual pushbuttons in the control room. The turbine was tripped locally at the front standard using the emergency trip lever at 0241. "Standard Post Trip Actions" were performed as per EOP-1 and the plant was stabilized in Mode 3, Hot

Standby.

The root cause of the reactor trip was inadequacy in the core axial shape index management guidelines. The root cause of the failure of the turbine to trip either automatically or by manual pushbutton was the failure of the turbine trip controls to perform their function because of a relay problem and particulate matter blocking a solenoid valve drain port.

Corrective actions for this event: Procedural changes have been implemented to provide additional guidance on axial shape index control. Additional guidance has been incorporated into EOP-1 on actions to take for a reactor trip with no subsequent turbine trip. A design change to the setpoint of the local power density pre-trip was also implemented. Modifications to the turbine control system were made allowing the turbine trip valves to be tested while the unit is online. Modifications were made to the control circuitry of the turbine providing continuous monitoring of wiring continuity. The effectiveness of these corrective actions will be evaluated for implementation on Unit 1.

END OF ABSTRACT

DESCRIPTION OF THE EVENT

On 21 April, 1992, with Unit 2 in Mode 1, a plant shutdown was in progress for a scheduled refueling outage. The unit had just completed a lengthy continuous run (502 days) and as a precaution, an extra senior reactor operator was assigned to the control room shift. As expected, difficulties in maintaining neutron flux axial shape index (ASI) within limits during the downpower were encountered. Maintaining ASI within limits became increasingly difficult since reactor power, reactor coolant system (RCS) (EIIS:AB) temperature and Xenon buildup were each affecting ASI. With reactor power at approximately 15%, control rod (EIIS: AA) insertion on lead control bank #5 was no longer having any effect on continuing ASI. Three of four local power density (LPD) pre-trips in the reactor protection system (RPS) (EIIS:JC) actuated. At 0238 the nuclear plant supervisor (NPS) directed the reactor control operator (RCO) to manually trip the reactor. On the manual reactor trip the turbine (EIIS:TA)did not trip automatically, but remained tied to the system grid carrying approximately 90 megawatts. Several additional attempts were made to trip the turbine from the manual turbine trip pushbuttons (EIIS:JJ) on the control room console. In addition, the main steam isolation valves (MSIVs)(EIIS:SB) were closed, the digital electro-hydraulic control (DEH) (EIIS:TG) pumps were secured and the

nuclear watch engineer (NWE) was directed to trip the turbine locally with the emergency trip lever at the front standard of the turbine. The turbine was tripped locally at 0241 with all turbine valves indicating closed. The lowest RCS temperature reached was 525 degrees Fahrenheit. "Standard Post Trip Actions" were performed as per EOP-1 and the plant was stabilized in Mode 3, Hot Standby.

CAUSE OF EVENT

Manual Reactor Trip:

Difficulties in controlling ASI were expected due to the high degree of core burnup. This had been discussed prior to the shutdown by operations department supervision and a decision made to trip the reactor manually if ASI control could not be maintained throughout the downpower. The shutdown of the reactor was performed in a slow and conservative manner. As expected, during the downpower ASI became more negative. ASI was being compensated through control rod insertion on group #5, the lead group. At approximately 15% reactor power and 85 inches withdrawn on group #5, control rod insertion was no longer providing the desired effect on ASI. The reactor was tripped as per previous decisions.

Turbine Trip Failure:

The cause for the failure of the automatic and manual pushbutton turbine trips was investigated by a multidiscipline team. Members of the team included representatives from maintenance, operations, system engineering, design engineering, and the turbine vendor. Extensive vendor input was obtained and a failure analysis plan was prepared. Several key components were carefully removed and se
t to an independent
lab for evaluation in the "as found" condition. Hydraulic fluid samples were also taken and analyzed. A test procedure was written and performed to evaluate the operation of all turbine trip functions. A complete circuit wiring inspection was performed.

CAUSE OF EVENT (CONTINUED)

Turbine Trip Failure (cont'd):

The failure of the turbine to trip automatically was caused by unrelated failures in the two redundant and electrically independent automatic turbine tripping schemes.

Turbine trip testing showed that turbine trip solenoid valve 20 AST failed due to an intermittent loss of circuit continuity. The wiring inspections revealed two deficiencies at relay 62 ASTX either of which could have caused such a failure. The deficiencies were a loose terminal connection in the circuit at the relay and burned relay contacts within the relay.

Independent lab disassembly and examination of solenoid 20 ET revealed that particulate matter was blocking a small port which prevented the solenoid valve from dumping the turbine hydraulic fluid and tripping the turbine. Two other identical solenoid valves also connected to the same hydraulic system were clean. Samples of the hydraulic fluid did not contain the type of particulate found in 20 ET. The origin of the particulate could not be determined.

Because these two unrelated failures could not be detected with the existing system design and surveillance program, a loss of the automatic turbine the capability resulted.

The mechanical and electrical turbine overspeed trips were fully functional but were not challenged during the event. The associated manual trip lever at the turbine front standard did trip the turbine when actuated by the operator during the event.

ANALYSIS OF EVENT

This event is reportable under 10 CFR 50.73.a.2.iv. as "Any event or condition that resulted in manual or automatic actuation of any engineered safety feature, including the reactor protection system." The NPS decided to manually trip the reactor upon the receipt of the third LPD pre-trip in anticipation of an automatic RPS actuation.

The turbine did not trip automatically or manually and was locally tripped approximately three minutes after the reactor trip. The MSIVs were closed by the RCO at 0239 which terminated the event. The plant response to this event is bounded by section 15.1.5 of the PSL Unit 2 Final Safety Analysis Report (FSAR), "Increased Heat Removal by the Secondary System" as further described below:

1) With a reactor trip at 15% power and with no operator actions taking place, the MSiVs will automatically close when the pressure in a steam generator reaches 600 psia and the cooldown event will be terminated. This cooldown rate is bounded by the linking FSAR cooldown event.

2) With a reactor trip at 100% power and with no operator actions taking place, there will be a safety injection actuation signal (SIAS) (EIIS:BQ)

received but there will be no actual injection. The MSIVs will automatically close when the pressure in a steam generator reaches 600 psia and the cooldown event will be terminated. The cooldown rate is bounded by the FSAR cooldown event as confirmed by in-house RETRAN analysis.

ANALYSIS OF EVENT (CONTINUED)

3) With a reactor trip at 100% power in an FSAR Chapter 15 Accident Scenario (ie. Excess Steam Demand with single failure of the turbine stop valves to dose), with operator action, the safe shutdown of the reactor will be achieved because operators are trained to handle Design Basis Accidents. Multiple failures are procedurally addressed by Emergency Operating Procedures.

CORRECTIVE ACTIONS

1. Procedural changes were implemented to provide additional guidance for ASI control.

2. Procedural changes were incorporated into EOP-1 providing additional guidance on actions to take for a reactor trip with no subsequent turbine trip.

3. A design change to the setpoint of the local power density pre-trip has been implemented during this refueling outage. Due to hardware limitations the pre-trip setpoint had been at a lower than desired setting. With the installation of new hardware the pre-trip setpoint was moved closer to the trip setpoint and is now at the same setting as Unit 1.

4. A modification to the turbine trip control system has been implemented to provide for continuous monitoring of control circuitry integrity.

5. A modification has been made to the turbine control system hardware allowing online testing of the turbine trip and overspeed protection solenoids.

6. An increased inspection frequency for the 20 AST circuit deenergizing relay has been added to preclude future burnt contacts.

7. The effectiveness of these corrective actions will be evaluated for implementation on Unit 1.

ADDITIONAL INFORMATION

Component Failures

Relay, Agastat Solenoid valve, Parker Hannifin
Model 7012 PCL Valve ID # SE22185
S/N 78441891 Model (pilot assembly), R6V2DHV50X2252
125 volt DC

Previous Similar Events

The only similar event for a reactor trip caused by local power density is described in Licensee Event Report 389-86-001. This event was an automatic trip, during power ascension, caused by personnel error. There have not been any previous events where the turbine failed to the following a reactor trip.

ATTACHMENT 1 TO 9207060235 PAGE 1 OF 1

P.O. Box 128, B. Pierce, FL 34954-0128
FPL June 29, 1992

L-92-169
10 CFR 50.73

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Re: St. Lucie Unit 2
Docket No. 50-389
Reportable Event: 92-001
Date of Event: April 21, 1992
Manual Reactor Trip Due to
Local Power Density Control
Supplemental Report

The attached Licensee Event Report is being submitted pursuant to the requirements of 10 CFR 50.73 to provide notification of the subject event.

Very truly yours,

D. A. Sager
Vice President

St. Lucie Plant

DAS/JWH/kw

Attachment

cc: Stewart D. Ebneter, Regional Administrator, USNRC Region II
Senior Resident Inspector, USNRC, St. Lucie Plant

DAS/PSL #717-92

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